RESEARCH ARTICLE

Anecdotes in Primatology: Temporal Trends, Anthropocentrism, and Hierarchies of Knowledge

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ABSTRACT Formal narrative descriptions of primates have long been used by primatologists to describe novel events that are not captured by other data collection methods. However, there has been a shift away from narrative accounts toward more quantitative methods both within primatology and more broadly in the natural sciences. Our objective was to investigate the shifting use of anecdotal evidence in primatology. We systematically reviewed anecdotal accounts published in the four major primatology journals since the year 2000. We found 163 published anecdotal accounts out of 3,960 total articles published between 2000 and 2016. There was an overall decrease in the rates of anecdotes published during this time. Those published covered a wide range of topics and taxa but were skewed toward larger, diurnal primates—in particular, apes. We suggest that anecdotal evidence should continue to be published but that the publication of these data should better reflect the taxonomic diversity of primates. We also suggest potential venues for anecdote publication that may compensate for their loss from formal scientific journals. [*narratives, qualitative data, anthropomorphic, primates, observation*]

RESUMEN Las descripciones narrativas formales de primates han sido utilizadas por largo tiempo por primatólogos para describir eventos novedosos que no son capturados por otros métodos de colección de datos. Sin embargo, ha habido un distanciamiento de los relatos narrativos hacia métodos más cuantitativos tanto dentro de la primatología como más ampliamente en las ciencias naturales. Nuestro objetivo era investigar el uso cambiante de evidencia anecdótica en primatología. Revisamos sistemáticamente los relatos anecdóticos publicados en las cuatro revistas académicas principales de primatología desde el año 2000. Encontramos 163 relatos anecdóticos publicados de un total de 3.960 artículos. Hubo una disminución general en las tasas de anécdotas publicadas durante este tiempo. Aquellas publicadas cubrían un amplio rango de temas y taxones, pero estaban sesgadas hacia primates diurnos, más grandes –en particular, simios. Sugerimos que la evidencia anecdótica debe continuar siendo publicada, pero que la publicación de estos datos debe reflejar mejor la diversidad taxonómica de los primates. También sugerimos lugares potenciales para la publicación de anécdotas que pueden compensar por su pérdida de las revistas académicas formales. [*narrativas, datos cualitativos, antropomórfico, primates, observación*]

RÉSUMÉ Des descriptions narratives formelles ont longtemps été utilisées par les primatologues pour décrire des phénomènes nouveaux observés. Toutefois, une transition vers l'utilisation de méthodes quantitatives plutôt que de comptes-rendus narratifs a progressivement été observée en primatologie. L'objectif de cette recherche était d'examiner cette transition en faisant une revue systématique des comptes-rendus anecdotiques publiés dans

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les journaux de primatologie. Nous avons trouvé 163 anecdotiques sur un total de 3960 articles publiés entre 2000 et 2016 et avons observé une diminution du nombre de comptes-rendus publiés pendant cette période. Les anecdotes publiées portaient sur un grand nombre de sujets et de taxons, mais portaient davantage sur de larges primates diurnes, et surtout sur des grands singes. Nous croyons que des comptes-rendus anecdotiques méritent d'être publiés, mais qu'ils devraient refléter davantage la diversité des primates. Par ailleurs, nous proposons dans cet article d'autres types de sources où ces anecdotes pourraient être publiées. [*récit, données qualitatives, anthropomorphique, primates, observation*]

The natural sciences are undergoing substantial changes in the twenty-first century. Advances in methods such as genomics, multivariate statistics, and computational simulations are providing biologists, in particular, with an unprecedented tool kit with which to examine the natural world (Losos et al. 2013). These advances have brought about fascinating discoveries in the new millennium, but there is a growing worry that these advances are coming at the expense of direct observations of organisms' natural histories (Able 2016; Greene 2005). Primatology is a unique natural science that, because of its birth in anthropology and other social sciences, straddles the social and natural sciences (Haraway 1989; Rees 2007; Strum and Fedigan 2000). Thus, primatology might be uniquely equipped to face these rapidly evolving challenges of biology in the new millennium. This study will explore how these greater trends in the natural sciences impact the discipline of primatology. Specifically, we critically analyze the modern use of anecdotes within primatology with specific reference to potential anthropocentric biases and effects on knowledge transfer, and we offer recommendations about how anecdotes can be (re)integrated into primatological literature.

NATURAL HISTORY AND THE HISTORY OF PRIMATOLOGY

Natural history is broadly defined as the direct observation of organisms in a natural environment (Able 2016). Different definitions exist for natural history, but most focus on the methods of natural history being descriptive observation of organisms without experimental manipulation (Greene 1986; King and Achiam 2017). The decline of natural history within biology is not a new concept and has been discussed in detail in many places (Able 2016; Dayton 2003; Greene 1986, 2005; Greene and Losos 1988). In particular, discussions have highlighted the loss of undiscovered natural history information through biodiversity declines (Dayton 2003; Tewksbury et al. 2014) and the potential benefits of natural history research in preventing these declines (Able 2016; Vallejos and Morimoto 2013). Yet, others have argued that new methods in biology, such as genomics, are only expanding the way in which natural history is described rather than leading to a decline (Arnold 2003). In this sense, natural history is being complemented by new methods, and these methods are removing many of the biases in natural history that come from a lack of experimentation (Greene 2005; King and Achiam 2017). Entangled within these disciplinary shifts is an increase in complexity and decrease in the readability of published scientific research, making scientific knowledge less accessible to nonspecialists entering the field or those with limited resources (Cordero et al. 2016; Plaven-Sigray et al. 2017).

Primatology is not immune to these broader shifts within the natural sciences, but the discipline has a unique history that perhaps allows a more holistic understanding of knowledge. The roots of primatology start with early studies of captive and wild nonhuman primates (hereafter referred to as "primates") in the early twentieth century, but the discipline greatly expanded after the Second World War (Strum and Fedigan 2000). In Europe and North America, studies were primarily carried out by anthropologists interested in primates as model organisms for questions of human evolution (Washburn and DeVore 1961). Because of these roots in anthropology, much of primatology has focused on topics that are more interesting to human evolution, such as cognition and sociality, and on key species of Old World monkeys and apes (Haraway 1989; Strum and Fedigan 2000). This has presented a conundrum for primatologists, as primates have a disproportionate amount of research (and thus funding, job opportunities, etc.) focused on them compared with other animal taxa, yet there are many areas of research that have only recently received attention due to their lack of relevance to anthropology as a discipline (Rees 2007).

In Japan in the middle of the twentieth century, a parallel primatology emerged to examine primate social systems, integrating a Japanese "style" of descriptive and ethnographic writing (Asquith 2000; Takasaki 2000). This Japanese style was inspired by the cultural and spiritual norms that saw humans and animals as one, rather than by Western views of the human–animal dichotomy (de Waal 2003). By the latter part of the twentieth century, quantitative methods and advanced analyses became the norm across national primatological traditions (Altmann 1974), but primatology remained a unique field among other zoological disciplines. Primatology was a field that challenged human exceptionality and misogyny, and broke down international barriers (Strum and Fedigan 2000). Despite this rather informed and self-aware method of science, primatology has struggled (and largely still struggles) with race, gender, and ethical issues (Antón, Malhi,

and Fuentes 2018; Haraway 1989; Rees 2001; Turner et al. 2018). For example, even though the majority of primatologists identify as women, men still occupy more senior academic roles (Addessi, Borgi, and Palagi 2012).

In the new millennium, primatologists have become increasingly concerned with the conservation of the species they study (Behie, Teichroeb, and Malone 2019; Chapman and Peres 2001). Worldwide, primates are undergoing rapid population declines; about 60 percent of species from across all habitat regions are threatened with extinction (Estrada et al. 2017). Global and regional-scale factors leading to these declines are relatively well understood and include processes such as hunting, habitat loss, and wildlife trafficking (Chapman and Peres 2001; Estrada 2013). However, small-scale factors, such as species-specific habitat preferences, local laws and customs, and spirituality, also play an important role in species declines (Gardner 2011, 2014; Riley 2010; Waters, Bell, and Setchell 2018). Primatologists in the new millennium are wielding a unique set of tools in order to avert this impending extinction crisis. In particular, primatologists have integrated traditional anthropological approaches, such as ethnography, into their work (Malone et al. 2014).

ANECDOTAL EVIDENCE WITHIN PRIMATOLOGY

Throughout this history of primatology, anecdotal evidence has been a vital source of knowledge transfer. Early accounts of wild primates were often purely anecdotal (see examples from the late eighteenth and early nineteenth centuries in Zuckerman [1932]) before animals were habituated and more quantitative methods for data collection became standard (Altmann 1974; Burghardt 1988). Some of the most interesting primatological discoveries of the last one hundred years, such as tool use and hunting, came out first in the form of anecdotal accounts (Goodall 2010) and were then identified and analyzed across the field (on tool use, see Beck 1980; Breuer, Ndoundou-Hockemba, and Fishlock 2005; Galdikas 1982; Van Schaik, Deaner, and Merrill 1999; Visalberghi 1990; Watanabe, Urasopon, and Malaivijitnond 2007; on hunting, see Butynski 1982a; Fan and Jiang 2009; Fedigan 1990; Goffe and Fischer 2016; Hosaka et al. 2001). Anecdotes continue to be important today in driving the field of primatology forward. For instance, the occurrence of infanticide and predation are often reported anecdotally (on infanticide, see Arcadi and Wrangham 1999; Digby 1995; Hrdy 1977; Moos, Rock, and Salzert 1985; Teichroeb and Sicotte 2008; on predation, see Bianchi and Mendes 2007; Isbell 1990; Matsuda, Tuuga, and Higashi 2008; Peetz, Norconk, and Kinzey 1992), yet are important influences on selection in primates (Isbell 1994; Van Schaik 1983; Van Schaik and Janson 2000; Van Schaik and Kappeler 1997). Collections of anecdotal reports have been particularly useful in revealing primate cognitive abilities (Bates and Byrne 2007; Mitchell 1997a; Whiten and Byrne 1988). Whiten and Byrne's (1988) paper on tactical deception in primates encouraged the reporting of rare, anecdotal observations in the realm of primate cognition, which has since led to quantitative experiments being conducted in several taxa.

An anecdote can be defined as the *account* of a behavior or event that is either singularly or very rarely observed (Sarringhaus, McGrew, and Marchant 2005). Important in this definition is the act of observation. Anecdotal evidence can come from common events, such as birth or death, that are just rarely physically observed by researchers because of observational conditions or behaviors that preclude human observation (such as the human shield effect: the habitual avoidance of primate groups by predators when researchers are present; Nowak et al. 2014). Additionally, the type of activities that are rare or rarely observed can be species and location specific; the observation of infanticide can be relatively common in one species, thus allowing for quantitative analyses (e.g., Borries et al. 1999; Teichroeb et al. 2012), while in another species this particular behavior may be only observable in rare circumstances and thus is better suited for anecdotal reports (e.g., Butynski 1982b; Struhsaker 1977). These differences in observational data may or may not reflect true biological differences but rather ease of observation in different locations due to factors such as arboreality, vegetation density, nocturnal activity patterns, or body size (Bates and Byrne 2007).

One of the strongest arguments for the rapid publishing of anecdotal accounts is that they showcase interesting behavioral patterns before longer-term studies or analyses can be conducted and published (Sarringhaus, McGrew, and Marchant 2005). Anecdotal data in primatology are often collected during the course of a larger project and then published as short papers with reference to larger evolutionary or ecological questions. Such is the case with the observation of gelada monkeys feeding on locusts during a brief outbreak (Fashing, Nguyen, and Fashing 2010), which was part of a long-term study of gelada feeding ecology (Fashing et al. 2014). The benefit of publishing anecdotal accounts during long-term studies is that other researchers may become aware of behaviors to look out for in their own study systems, thus allowing for knowledge transfer. Researchers have become aware of whole new fruitful areas of study because of anecdotal reports. For instance, zoopharmacognosy, or the ways in which animals self-medicate, was initially a set of anecdotes (Rodriguez and Wrangham 1993) and has since blossomed into a subfield in itself (Huffman 2016). Researchers have also been able to compare populations at different field sites for variability in cultural traditions (Hohmann and Fruth 2003; McGrew 1992; Perry et al. 2003; Santorelli et al. 2011; Van Schaik et al. 2003; Wich et al. 2012). Last, it is clear that anecdotal accounts captivate both the public and research communities alike due to their exciting nature. Such as the case of a narrative account of interspecies sexual behavior between a Japanese macaque and a sika deer in the journal *Primates*, which received widespread media attention (Pelé et al. 2017).

Nevertheless, reliance on anecdotal accounts has been heavily criticized (e.g., Bernstein 1988; Humphrey 1988;

Thomas 1988). Anecdotal evidence can be misleading (e.g., McKelvey, Aubry, and Schwartz 2008) or unrepresentative of actual animal behavior, and thus anecdotal accounts are often placed below more-rigorous quantitative data in hierarchies of knowledge production (Aronson 2005; Rollin 2000). Early anecdotal accounts in primatology were criticized for focusing on only the most exciting events, with all of the interpretation of what is exciting left to the observer. This led to a heavy focus on male/masculine topics, such as male social relationships, dominance, or aggression (Haraway 1989; Strier 1994). Anecdotal studies can be misrepresented in citations when they are used in reviews, meta-analyses, or textbooks that do not acknowledge low sample sizes and thus are passed on as established knowledge despite not possessing the statistical power of more quantitative studies (Sarringhaus, McGrew, and Marchant 2005).

The other main criticism of anecdotes and anecdotal studies is that they are rife with anthropomorphic and anthropocentric bias (Burghardt 1988). There is a long debate between scientists who see humans as distinct, and thus incomparable, from all other forms of life on earth (Rollin 2000) versus those who stress that humans are animals as well and are subject to the same evolutionary and physiological forces as all other animals (Pavelka 2002). For the latter researchers, many things like emotions, thoughts, and pain apply equally (or at least closely) between humans and animals (Asquith 2011), and are thus valid areas of scientific inquiry. Primatologists are uniquely situated in the anthropomorphism debate as those who study the closest living relatives of humans (Haraway 1989; Rees 2001). Indeed, the emerging field of ethnoprimatology seeks to break down these barriers even further and engage with animals and humans as members of the same ecological communities rather than separate forces (Fuentes 2012; Malone et al. 2014).

Anthropocentrism is the notion that humans are on top of a hierarchy of life on earth (Shoreman-Ouimet and Kopnina 2015). Practically speaking, in primatology, anthropocentrism is the bias toward organisms that are closer to humans phylogenetically, whether that be great apes, Old World monkeys, or more broadly the study of primates as opposed to other taxa (Rees 2001). Early primatology focused on a few, relatively easy-to-observe species or species that were particularly interesting to humans, which led to taxonomic biases toward chimpanzees and some terrestrial cercopithecines (Strum and Fedigan 2000). As primatology has expanded in the twentieth century, its focus has expanded to encompass a greater range of primates, although biases still exist (Doherty and Harcourt 2004; Hawes, Calouro, and Peres 2013; Nekaris and Bearder 2011). Anthropocentrism, much like anthropomorphism, is not necessarily negative. For many research questions, apes (or other primates) are often, but not always, the best animals for comparisons with humans and occupy a special place for humans scientifically, culturally, and spiritually (Haraway 1989). However, problems may emerge when anthropocentric bias excludes other taxa, either through reduced research opportunities, lack of publication prestige, or less funding for conservation action (Doherty and Harcourt 2004; Marshall and Wich 2016; Strier 1994).

It is important to note that anecdotes are not inherently anthropocentric nor anthropomorphic; an anecdote is merely a description of an event. Anecdotes may be written or interpreted in ways that end up ascribing human-like qualities to the animals (Russell 1997), perhaps because of their narrative nature (Quiatt 1997), which would imply anthropomorphism. An anthropocentric bias would occur if researchers focus on species that are phylogenetically closer to humans, such as great apes, as we are more likely to see our own features in them (Byrne 1997; Mitchell 1997b; Rollin 1997). This may lead to greater research effort on these species overall (evidence of an anthropocentric bias), which may lead to more published anecdotes on them. Conversely, if anecdotes are recorded—and, more importantly, published—more frequently on these more human-like species, this would show evidence of an anthropocentric bias within anecdotes themselves, as researchers and editors would be more likely to accept anecdotes from our closest relatives than other primates.

Though we know that anecdotes were frequently published early in the discipline of primatology, and the potential problems with these early accounts have been discussed elsewhere (Rollin 1997; Sarringhaus, McGrew, and Marchant 2005), the objective of this study was to critically analyze the continued use of published anecdotes on primates as major shifts occur within the natural sciences in the new millennium. We examined the rate and content of anecdote publication from 2000 to 2016 in the four major international primatology journals. We hypothesized that there would be a significant decrease in the total publication of anecdotal accounts over time as perceived standards for publication increased. We predicted that this general decrease would not be linear across all journals, because different journals have different aims, scopes, and histories. Given that anecdotes may be more prone to anthropocentric bias, we additionally hypothesized that there is a taxonomic bias in published anecdotal accounts. We predicted that a greater proportion of anecdotal accounts have been published on primates more closely related to humans, in particular apes, in relation to overall rates of publication, and more than would be predicted based on the number of recognized species.

MATERIALS AND METHODS

For the purposes of this study, an anecdote was explicitly defined as any report of a singular or rare event or behavior that included an observational narrative or description. This included observations of multiple individuals following a single event and multiple observations of a single individual over time. Studies that simply had a small sample size ($N = 1$) but had no anecdotal narrative (i.e., a single tissue sample analyzed) were not included.

MSR systematically searched for the use of anecdotal evidence from 2000 to 2016 in the four major international English-language primate journals—*American Journal of Primatology* (*AJP*), *Folia Primatologica* (*FP*), *International Journal of Primatology* (*IJP*), and *Primates*—using Web of Science searches (not including articles available online-only at the end of 2016). These four journals were chosen due to their international audience, access in online databases, and sole focus on primatology. Abstracts and methods of all peer-reviewed articles were analyzed to determine if anecdotal evidence was used. Articles were considered anecdotal if the primary focus of the report was an anecdotal account or rare event, even if there was additional supplemental data included. Both field-based and captive studies were considered as long as all other criteria were met. Articles were categorized based on year of publication, taxonomic focus (apes, Old World monkeys, New World monkeys, tarsiers, lemurs, or nonlemur strepsirrhines), and type of behavior observed (such as infanticide, birth, death, or social behavior). Taxonomic information was usually presented in the title and/or abstract, but if there was ambiguity (i.e., due to common names), we searched the article for exact taxonomic classification. We subcategorized various taxonomic groups, such as lemurs, other strepsirrhines, and tarsiers, which do not necessarily reflect phylogenetic relationships, in order to investigate possible bias in different groupings. Various articles could theoretically fall under multiple categories (i.e., chimpanzee predation on colobines can be predation or hunting) in which case the dominant category was chosen based on article title and/or author-chosen keywords from the article. We included articles focusing on cross-species interactions under multiple species categories. We additionally collected data on all articles published (minus meeting notes, introductions to special issues, and book reviews) in the four journals as well as the taxonomic focus of these articles in order to look at rates of publishing anecdotes and to ascertain if taxonomic bias was present only in anecdotal accounts or in all the articles published.

We compared the rate of anecdote publication (number of anecdotes published/all articles published) between the four journals using a Kruskal-Wallis test with Dunn's post-hoc tests. Trends in anecdote publication over time from 2000 to 2016 were examined for each journal, and over all journals together, using Spearman correlations. In addition, because *AJP* discontinued the publication of "brief reports" after 2010, we analyzed whether this impacted their rates of anecdote publication with a Mann-Whitney U test. Visual comparisons of the taxonomic distribution of anecdotes versus total research effort were done by examining the total percent of anecdotal and research papers focusing on primates in six categories: apes, Old World monkeys, New World monkeys, tarsiers, lemurs, and other strepsirrhines. As these categories vary in the number of species they represent (apes ~23 species, Old World monkeys ~134 species, New World monkeys ~151 species, tarsiers ~10 species, lemurs ~99 species, other strepsirrhines ~29 species), we divided the percentages of papers focusing on each group by the number of species in that category using the primate taxonomy in the IUCN red list (www.redlist.org). This gave us an estimate of research effort per species in each category (Table 1). Within the apes, Old World monkeys, New World monkeys, and lemurs, we used Z-ratios to statistically compare the proportion of nonanecdote articles on that group overall with the proportion of anecdotal articles to determine if one group was more or less represented in anecdotes compared to the overall research on them. Calculations of Z-ratios were not possible for tarsiers or other strepsirrhines dues to low sample sizes. Statistics were two-tailed and run in R version 3.2.2 (R Core Team 2015), with an alpha level of 0.05 set for significance.

TABLE 1. *Percent of Articles Published on Species in Each Taxonomic Category (A = Apes, OWM = Old World Monkeys, NWM = New World Monkeys, OS = Other Strepsirrhines, L = Lemurs, T = Tarsiers, PRO = Prosimians) for Each of the Four Primatology Journals (*American Journal of Primatology = *AJP,* Folia Primatologica = *FP,* Primates = *P,* International Journal of Primatology = *IJP)*

All articles published

	A	OWM	NWM	OS	L	T	Total PRO
IJP	22.7	33.6	26.8	1.7	13.3	1.9	16.9
AJP	23.9	35.0	30.3	1.7	8.9	0.2	10.8
P	33.5	37.7	21.5	0.9	5.8	0.6	7.3
FP	17.1	29.7	27.8	4.5	20.1	0.8	25.4
Total	24.3	34.0	26.6	2.2	12.0	0.9	15.1
Ave/sp.*	1.1	0.3	0.2	0.1	0.1	0.1	0.1
Strep only				18.5	81.5		
Ave/sp.				0.63	0.82		

Anecdotes only

Anecdotes	A	OWM	NWM	OS	L	T	Total PRO
IJP	33.3	40.0	20.0	0.0	6.7	0.0	6.7
AJP	32.5	20.0	35.0	0.0	12.5	0.0	12.5
P	31.9	36.2	26.1	0.0	4.3	1.4	5.7
FP	15.4	35.9	28.2	2.6	15.4	2.6	20.6
Total	28.6	32.9	28.6	0.6	9.3	1.2	11.1
Ave/sp.*	1.2	0.2	0.2	0.0	0.1	0.1	0.1
Strep only				6.3	93.7		
Ave/sp.				0.22	0.95		

*Average proportion of articles per species in that taxonomic group (Figure 4).

RESULTS

Across the four primatological journals, we found a total of 163 anecdotal studies published from 2000 to the end of 2016. Of these accounts, the vast majority were from wild or free-ranging animals ($N = 156$, 95.7 percent). All four journals published anecdotal accounts during this period. However, these studies were not evenly distributed across the four journals, with *Primates* ($N = 69$, 9.2 percent of all articles published in this journal) having the plurality of anecdotal studies and *IJP* ($N = 15$, 1.3 percent) having the least. *AJP* and *FP* published 40 (2.5 percent) and 39 (8.6 percent) anecdotal accounts, respectively. Overall, these four journals published 3,960 (*AJP*: $N = 1{,}592$, *FP*: $N = 455$, *IJP*: $N = 1{,}165$, *Primates*: $N = 748$) articles that were included in our analyses of rates and taxonomic biases when extraneous nonscientific material (such as society meeting reports or obituaries) was removed.

Anecdotal accounts were often presented differently from other articles. Accounts often followed a narrative of events sometimes with potentially anthropomorphic language, such as this description of the death of a Barbary macaque (MA):

> Two adult males (RG and IS) climbed the tree and approached [MA], teeth-chattering and lip-smacking, behaviors associated with reassurance and reconciliation. Both monkeys were observed *delicately* touching and inspecting the wounds. As the other group members left the tourist site to go into the forest to sleep they made several "long-calls," *presumably to MA*, from approximately 100 m away; such calls are usually used when an individual is separated from the group or the group is searching for a separated individual. (Campbell et al. 2016, 310–11; emphasis added)

Other accounts stated observations alongside detailed descriptions, such as this description of a chimpanzee's reaction to an earthquake:

> [Tarnie] came down to the ground during the tremor. She held the tree with her left hand and stood on her hind legs. Then, she placed her right palm on the ground and looked at it for 9 s. After this, she moved close to the observation trail and stood on all four limbs with her forelegs in the knuckle position. Subsequently, she extended her right hand forward and placed it palm down on the ground for 11 s. The ground was covered with small stones and without grass. After the tremor stopped, she climbed back into the tree she had previously occupied. (Fujimoto and Hanamura 2008, 75)

The rates of publishing anecdotes varied significantly between journals (Figure 1; Kruskal-Wallis, $H = 28.24$, $df = 3$, $p < 0.0001$). Post-hoc analysis revealed that the *AJP* and *IJP* published significantly fewer anecdotal accounts than *FP* and *Primates* (Dunn's test, *AJP* vs. *IJP*: $z = 1.34$, $p = 0.085$; *AJP* vs. *FP*: $z = -2.02$, $p = 0.022$; *AJP* vs. *Primates*: $z = -3.59$, $p = 0.0002$; *IJP* vs. *FP*: $z = -3.39$, $p = 0.0003$; *IJP* vs. *Primates*: $z = -4.97$, $p < 0.0001$; *FP* vs. *Primates*: $z = -1.58$, $p = 0.058$). Rates of anecdote publication also varied over time (Figure 2). The publication of anecdotes significantly decreased from 2000 to 2016 in *AJP* (Spearman, $N = 17$, $r_s = -0.591$, $p = 0.013$) and *FP* ($N = 17$, $r_s = -0.751$, $p = 0.0004$), while there was no significant change

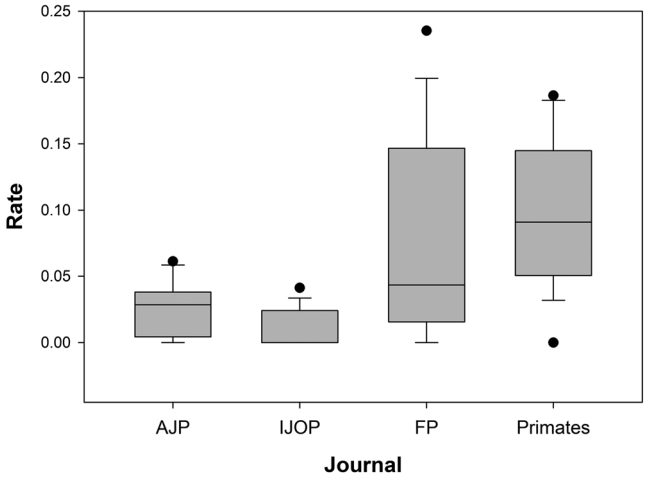

FIGURE 1. *Box plots comparing the distributions of the yearly rates of anecdote publication in the four primatology journals from 2000 to 2016.*

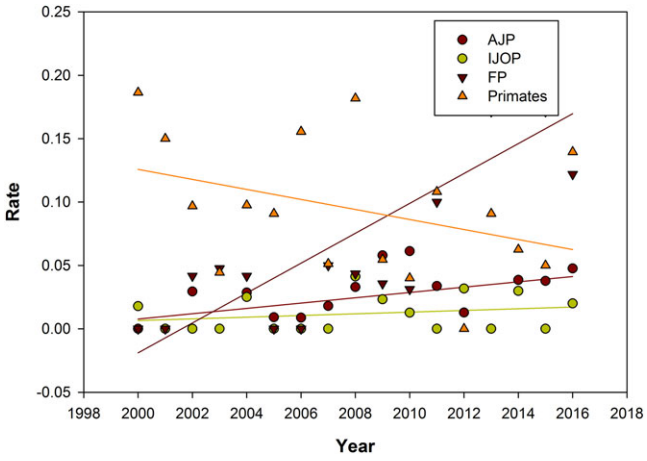

FIGURE 2. *Changes in the rates of anecdote publication from 2000 to 2016 in the four primatology journals with trend lines. [This figure appears in color in the online issue]*

in *IJP* ($N = 17$, $r_s = -0.25$, $p = 0.332$) or *Primates* ($N = 17$, $r_s = 0.361$, $p = 0.154$). Yearly rates of anecdote publication from 2011to 2016 were significantly lower than during the period from 2000 to 2010 (Mann-Whitney U, $N_{pre} = 11$, $N_{post} = 6$, $U = 54.5$, $p = 0.035$). When all four journals were combined, a composite rate of anecdote publication in primatology showed that publication of these types of articles is decreasing significantly over time ($N = 17$, $r_s = -0.615$, $p = 0.009$).

Anecdotal articles ranged greatly in subject matter (Figure 3). Articles published on infanticide ($N = 28$), predation ($N = 26$), and birth ($N = 23$) were the largest categories. No trends were observed among different journals or over time in the rates of study topics, although sample sizes were small in each individual category.

The majority of literature, anecdotal or not, focused on monkeys and apes, with 90.1 percent ($N = 147/163$) of anecdotes and 87.6 percent ($N = 3{,}470/3{,}960$) of overall articles primarily focusing on this one clade (Table 1),

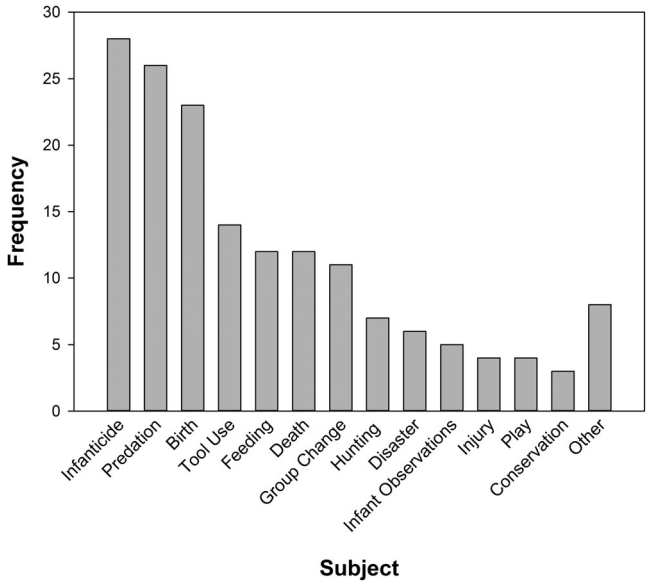

FIGURE 3. *The frequencies of the subjects of anecdotal narratives published in the four primatology journals from 2000 to 2016.*

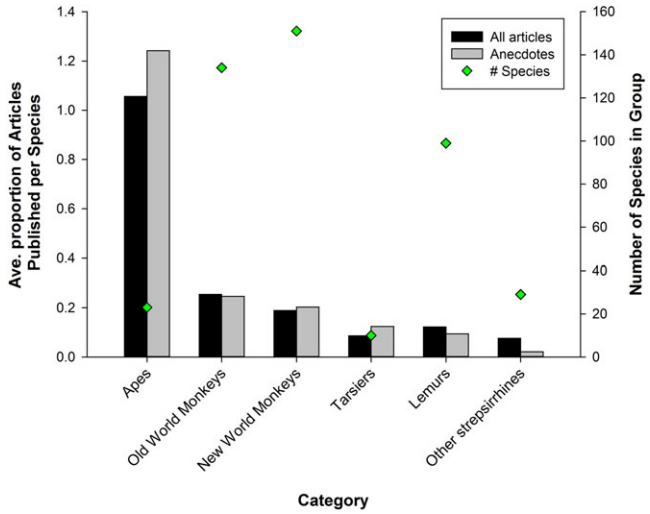

FIGURE 4. *The percentage of articles per species in each taxonomic category that were the subject of all research published compared to just anecdotes published with all four journals lumped. [This figure appears in color in the online issue]*

which contains approximately 68 percent of recognized primate species. Similarly, among strepsirrhine primates, 83.4 percent ($N = 15/18$) of anecdotes and 81.5 percent ($N = 398/488$) of all articles focused on lemurs as opposed to other strepsirrhini. When we controlled for the relative proportion of articles and anecdotes across the six taxonomic groupings, apes were determined to be overrepresented in both the anecdotal and overall literature (Figure 4). For example, 46 anecdotes were published on apes (~23 species recognized), while 15 were published on lemurs (~99 species recognized). The taxonomic biases observed for anecdotal accounts were mirrored in the overall taxonomic biases in all published articles; Z-ratios were not significant for any group that could be examined (apes: $z = -1.17$, $p = 0.24$; Old World monkeys: $z = 0.45$, $p = 0.65$; New World monkeys: $z = -0.37$, $p = 0.71$; lemurs: $z = 0.6$, $p = 0.55$), which indicates that the ratio of anecdotes was not different from the ratio of all articles based on these groups. While sample sizes were too small to test statistically, the differences in research effort between lemurs and other strepsirrhines largely disappeared by controlling for taxonomic distribution overall (Table 1; 0.82 vs. 0.63) but showed taxonomic bias in anecdotes skewed toward lemurs (0.95 vs. 0.22).

DISCUSSION

Decline in Anecdotal Evidence

We found that despite representing a small fraction of all articles published, anecdotes continue to be published in the top four primatology journals with a downward temporal trend, thus validating our first hypothesis. The challenge of observing certain behaviors in field conditions has led to many anecdotal reports focused on events that are inherently common in an organism's life, such as birth and death. There were also many novel behaviors or events reported, such as same-sex sexual behavior (Fox 2001) or vehicular mortality (McLennan and Asiimwe 2016), that could lead to further research. However, there were several categories that seemingly could only be presented as anecdotes. For instance, Fujimoto and Hanamura (2008) opportunistically observed the reactions of chimpanzees to an earthquake that occurred during data collection, and another team of researchers happened to observe a group of bonnet macaques swimming, the first for the species (Agoramoorthy et al. 2000). It is difficult to see how these events, which may provide important context for behavioral or ecological questions in these species, could be reported or quantified in any other way besides anecdotal narratives.

Taxonomic Biases

Our analyses show that there is a significant taxonomic bias toward apes in the publication of anecdotes. However, this bias is likely due to the overall taxonomic bias in published articles rather than a bias in the method of collecting anecdotes; when we examined all published literature in the target journals over the same time period, they had a similar level of bias toward apes. Thus, our second hypothesis was not validated; the publication of anecdotes in primatology does not appear to have an anthropocentric bias. We are careful to note that our analyses focused on publication rather than acceptance, so we currently cannot determine if there is a taxonomic bias in the acceptance of anecdotes. Difficulties in observational conditions may explain our findings on the lack of publications on tarsiers and nocturnal strepsirrhines (Gursky 2011; Nekaris and Bearder 2011; Setchell 2012), and the greater representation of diurnal lemurs relative to nocturnal, solitary lemurs in research effort (Gould and Sauther 2011). Nevertheless, our analyses show that there is a bias toward apes in the published literature when the

number of species in each taxonomic category is controlled for. As apes are not generally easy to habituate (great ape habituation time can take two to ten years, versus less than a month for most strepsirrhines; Williamson and Feistner 2011) or observe (Tutin and Fernandez 1991), this suggests that there is anthropocentric bias in the articles that get published in primatology journals, or in earlier processes, such as research funding and academic hiring decisions.

While apes occupy an important part of primatological discourse, we argue that these biases can be an issue because primatology as a whole seeks to examine how evolution impacts animals facing many different selective pressures, and the full range of selective pressures is not present just in the ape clade. For anthropological primatologists, recognizing that all primates (including humans) share a common ancestor and looking at different nodes of the evolutionary tree will answer a wider spectrum of questions of relevance to human evolution. Anecdotes are often important data points for larger reviews or meta-analyses on specific behaviors, such as prevalence of tool use across the order primates (Bates and Byrne 2007; Sarringhaus, McGrew, and Marchant 2005). Thus, anecdotes need to be reflective of the entire diversity of primates in order to be able to inform these larger studies. The continued publication of anecdotes on a wider variety of primates can help to circumvent some of this anthropocentric bias in the larger literature. As more researchers are able to overcome the logistical hurdles to reach previously understudied primates, we should be seeing more anecdotes.

Differences Between Journals

The four journals were not equal in the numbers or rates of anecdotes published. The journal *Primates* published the greatest proportion of papers based on anecdotal evidence, with rates of publication staying high through time. *Primates* is the journal of the Japan Monkey Centre and the Primate Society of Japan, and thus the continued acceptance of anecdotes can be seen as tied to the Japanese tradition of narrative primatology (Asquith 2000). Both *AJP* and *FP* have significantly decreased in their publication of anecdotes since 2000, while *IJP* had low rates of anecdote publication initially, and these rates stayed low over time. In 2011, *AJP* removed its "brief reports" publication option, which is where most anecdotes would be sent. While anecdotes continue to be published in *AJP*, the removal of the brief reports did have an impact on anecdote publication, which has decreased significantly in the period since 2010. According to Paul Garber (editor of *AJP* at the time that it stopped publishing brief reports) and Linda Fedigan (former editor of *AJP*, who recommended the change), the reasons that *AJP* discontinued the publication of brief reports were: (1) given page limits imposed by the publisher, primatology was thought to be better served by papers with stronger theoretical and empirical focus; (2) evaluation was difficult for reviewers and editors because the limited data in these papers did not allow hypothesis testing and results were often overexplained and tied to theory with limited evidence; and (3) an analysis showed that brief reports were rarely cited (P. Garber, L. Fedigan, personal communication).

Overall, taking into consideration articles published in all four journals, there has been a significant decrease in the publication of anecdotes in primatology over time. While our analyses cannot conclude causality, this decrease reflects, at least in part, editorial decisions on behalf of these journals. Further self-reflexive research should be done in collaboration with editors of these journals to determine if editorial decisions alone are responsible for falling rates of anecdote publication or if submissions are also decreasing because of other factors and if there are any anthropocentric biases in which anecdotes are accepted.

Consequences of the Decline in Anecdotes

What does a decrease in the number of published anecdotes mean for the field of primatology? Anecdotal narratives show primatologists trends to look for in upcoming research as well as showcasing the high rates of variability in the behavior of primates (Sarringhaus, McGrew, and Marchant 2005). If scientists are no longer able to publish anecdotes regularly, or anecdotes are relegated to perceived "lower-tier" non-peer-reviewed journals or regional newsletters, a great deal of knowledge may be lost. The knowledge passed on through published anecdotes is especially important to new and early career researchers who are looking for novel questions but may not have access to informal anecdotes directly through connections to established scientists. In this sense, the publishing of anecdotes can be seen as a formalized form of storytelling. If anecdotes are published widely, all primatologists will have access to these scientific narratives and thus the cutting edge of primatological science, rather than having to rely on knowledge being shared among exclusive groups at lab meetings or conferences. This democratization of knowledge through the publication of anecdotes can only help our field by bringing in new ideas and perspectives.

This is especially true given the history of primatology, in which more descriptive and narrative forms of primatology from Japan were ridiculed by Western primatologists (De Waal 2003), forcing Japanese primatologists to conform to Western standards in order to succeed in their careers (Asquith 2000). The Japanese example showcases that publishing diverse forms of knowledge gives space for a diversity of researchers. As Strum and Fedigan (2000) have pointed out, there are many other national traditions of primatology, despite most historical research coming from North American, European (mainly British), and Japanese institutions. These biases are reflected in the fact that the majority of people publishing in *IJP* are from wealthy, Western nations, while nationals from primate-range nations are being continually shut out of publication (Setchell and Gordon 2018). In addition to anecdotes, data based on folklore, oral histories, ethnographic work, and other nonquantitative sources can expand the field of primatology alongside more quantitative methods, although forums must be found for this knowledge

sharing. While reversing the declining use of anecdotes will certainly not fix primatology's diversity and inclusion issues (Antón, Malhi, and Fuentes 2018), the acceptance of alternative forms of knowledge is important for an international discipline such as primatology.

The declining use of anecdotal accounts may also be harmful to primate-conservation science and planning. Several anecdotes ($N = 3$) dealt directly with conservation practice, such as reintroduction programs, while many others dealt with topics that could to relevant to conservation practitioners such as those dealing with injury ($N = 4$), disaster ($N = 6$), death ($N = 7$), or birth ($N = 23$). For instance, McLennan and Asiimwe (2016, 6) provided the following account of a female chimpanzee (OL) killed during a road crossing in Uganda:

> Chimpanzees were crossing the road from north to south and some had already crossed. OL, carrying an infant, had crossed or was in the process of crossing when she turned back and was struck by a taxi car, which was reportedly traveling fast and did not stop. A "small" chimpanzee had apparently waited behind at the roadside; the schoolteacher suggested OL was returning to collect this younger individual. Afterwards, chimpanzees reportedly spent several minutes at, or near, the roadside vocalizing.

This case demonstrates why anecdotes can aid in primate conservation: speed of publication, accessibility of information, and emotional response. Anecdotes are meant to be produced and published much faster than long-form research articles, giving conservation practitioners access to relevant information quickly. In this case, the observed incident occurred on March 24, 2015, was sent to review in September 2015, and was published online on March 10, 2016, less than one year after the incident occurred (McLennan and Asiimwe 2016). Secondly, anecdotal accounts usually lack the complex quantitative analyses that are becoming increasingly common in the natural sciences (Cordero et al. 2016; Plaven-Sigray et al. 2017). While these types of analyses are important, especially when dealing with large-scale conservation issues (Estrada et al. 2017), they may not be as useful to small-scale conservation practitioners without specialized training, especially those in developing nations where most primates live, due to a lack of readability (Walsh, Dicks, and Sutherland 2015). Last, well-written anecdotal narratives, especially those involving incidents such as death, could be much more effective at eliciting emotional reactions, which can be powerful tools in aiding conservation action (Vining and Ebreo 2002). While we suggest anecdotes are useful for conservation planning in certain situations, we are careful to note that conservation practitioners and scientists have been criticized for the overuse of anecdotal evidence (Cook, Hockings, and Carter 2010; Murphy, Ferguson, and Gardner 2017).

Anecdotal accounts do not have to be lower than quantitative data in the hierarchy of knowledge production and are still important to primatologists. After all, the basic unit of anthropology, primatology's founding discipline, is the ethnography that relies heavily on narrative structure and anecdotal accounts (Clifford and Marcus 2010; Hurston 1935; Narayan 2007). Mitchell (1997b) and Bates and Byrne (2007) suggest that with certain questions, collections of anecdotes can and should be analyzed. Indeed, a better method than *ad libitum* sampling (i.e., anecdotes) for collecting rare, unanticipated events is not available (Altmann 1974; Byrne 1997). Our analyses show that in the new millennium, anecdotal accounts are still the only way to report on certain behaviors in primates, either behaviors that are common but hard to observe or behaviors that are reactions to uncommon events. As most anecdotes are narratives, if researchers strive to make them deeper and more comprehensive, with a greater amount of associated evidence, they will be maximally useful (Aronson 2005; McKelvey, Aubry, and Schwartz 2008). Anecdotes are theoretically reproducible and subject to validation, the hallmark of the scientific method, as long as researchers provide the proper information on context (Rollin 2000). However, while authors have a responsibility to make the reporting of anecdotal accounts accurate and useful, academics in positions of power, such as journal editors, reviewers, or executive members of academic societies, should also be aware of the value of anecdotal evidence.

Rather than rejecting anecdotal accounts out of hand, which appears to be the case as the number of published anecdotal accounts decrease and the avenues for their publication disappear, editors of primatology journals could carefully filter these papers to ensure only anecdotes of the greatest importance to primatology are published. Editors should consider the breadth of the order primates when making these editorial decisions. In certain primates, such as small nocturnal species, seemingly common behaviors that are readily observed and described in other primates may be currently impossible to quantify without the use of anecdotes. Last, editors can avoid conscious or unconscious anthropocentric bias by critically examining whether or not an anecdote is acceptable for publication because it comes from a closely related species to humans or whether it is sufficiently interesting by itself (i.e., would an article about an anecdote in a chimpanzee still be accepted if it was about a tarsier and vice versa).

Despite these recommendations, the decreasing trend in the publication of anecdotal data in primatology journals is unlikely to reverse. Alternative venues for these data are becoming imperative. Anecdotal accounts can be placed in regional journals, such as *Lemur News* or *Neotropical Primates*, as these journals are often read by conservation practitioners within their respective regions, although these journals do not have the same impact or reach as the broader primatology journals and often do not appear in online literature search engines. Anecdotal accounts can be published more frequently in monographs or edited volumes, which sometimes reach a broader spectrum of established researchers, early-career scientists, and students, but these tend to have long delays in publication. Anecdotal data can also be presented at professional meetings, where many

primatologists attend; however, if abstracts are not published, these data will not be part of a record that can be referred to by future researchers once the meeting is finished.

To further improve access to anecdotal data, venues such as blogs, editorials, forums, and websites dedicated to collecting and disseminating these accounts may need to be developed and used more frequently by primatologists. We stress that although these formats may become more necessary as publication of anecdotes drops in traditional academic media, these formats currently do not allow for the careful review and filtering of anecdotal accounts that is necessary to ensure that these data are reliable, nor do they have the same weight, in terms of "prestige," as peer-reviewed journals. Anecdotes, as with other forms of descriptive observational data, are prone to observer biases that can produce misleading results (Haraway 1989; Strier 1994). Thus, these types of data, perhaps even more so than quantitative data, deserve the peer-review process. Additionally, if anecdotal accounts do indeed democratize knowledge and help create new research questions, a positive incentive should be granted to those who publish these accounts. Given that primatology and the natural sciences have already entered the new millennium with exciting methods, theories, and whole new fields emerging, it seems plausible, too, that new forms of publication, scholarship, and incentive structures for academic work emerge as well.

CONCLUSION

Primatology as a field appears to be following trends within the natural sciences to eschew organismal natural history in favor of more quantitative methods. However, anecdotal evidence continues to be important in revealing the occurrence of rare behaviors, providing detailed descriptions of common but hard-to-observe events, and generating new hypotheses and areas of inquiry (Aronson 2005). These observations are incredibly valuable in animal-behavior studies and provide avenues for inclusion and inspiration in an increasingly complex scientific world. Journals should continue to regularly publish anecdotal studies that meet stringent standards of quality and should consider potential anthropocentric taxonomic biases in the acceptance of these articles. Editors and researchers should make sustained efforts to observe and report on the behavior of wild strepsirrhines and tarsiers for which data are sorely lacking (Gursky 2011; Nekaris and Bearder 2011; Setchell 2012). Those working on underrepresented taxonomic groups should continue to publish their findings both generally and anecdotally in order to share preliminary knowledge with other scientists and expand our knowledge of the order primates.

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NOTES

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